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This study investigates the carcinogenic and immunotoxic potential of embedded fragments of depleted uranium (DU) and a heavy-metal tungsten alloy (HMTA) to determine if carcinogenicity and immunotoxicity are correlated with tissue-metal content. We hypothesize that long-term chronic exposure to embedded DU and HMTA initiates changes in normal immune function that will eventually result in a carcinogenic response characterized by both tumor formation at the fragment implantation site (solid-state or foreign-body carcinogenesis) and at distant tissue sites ("true" carcinogenesis). To test this hypothesis, male Fischer 344 rats are surgically implanted with pellets of DU or HMTA. Responses in these rats are compared with those from rats implanted with a known carcinogen, nickel, or an inert metal, tantalum. At selected times after implantation, we assess tissue metal content, mutagenicity, and genotoxicity as well as perform tests to assess cell-mediated, humoral, and innate immunity. This report summarizes accomplishments of the project after the first year of work. Year one milestones are met: assays and other systems have been established and standardized, implant pellets and other materials contracted for and obtained, and over 300 rats have undergone pellet implantation surgery.

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INTRODUCTION

Depleted uranium (DU) and heavy metal tungsten alloys (HMTA) are components of battlefield munitions. DU was heavily used in the Persian Gulf War; HMTA are currently in use in the form of the so-called "green bullet" and are being tested as surrogate metals for DU in future anti-armor munitions. There is little information regarding the potential long-term health effects of exposure to these compounds, especially in the case of embedded shrapnel injuries. Two long-term health concerns are the carcinogenic potential of embedded DU and HMTA and the effect of the metals on the immune system. This study is designed to assess the carcinogenic and immunotoxic potential of DU and HMTA using the Fisher 344 rat model and standard National Toxicology protocols for such studies. Responses to the test metals are being compared to responses to tantalum, a biologically inert metal that serves as a negative control and nickel, a know heavy metal toxin and carcinogen that serves as a positive control. This research addresses the DOD effort to understand the potential health risks associated with DU and HMTA exposure in order to develop appropriate medical treatment protocols for personnel wounded by fragments of these metals.

BODY

Statement of Work

This research is an assessment of the immunotoxic and carcinogenic potential of embedded fragments of DU and HMTA in laboratory rats. Responses to these metals are compared to the biologically inert metal, tantalum, and the carcinogen and heavy metal toxin, nickel. For these experiments, rats are implanted with tantalum pellets alone (metal control group), a mixture of DU and tantalum pellets (low DU group), DU pellets alone (high DU group), a mixture of HMTA and tantalum pellets (low HMTA group), or HMTA pellets alone (high HMTA group). There is also a non-surgical control group and a positive carcinogenesis control group implanted with nickel pellets. Animals will be euthanized and various analyses performed 1, 3, 6, 12, 18, and 24 months after implantation. Analyses include histopathological examination and metal determinations as well as assessments of mutagenicity and cytogenicity. A battery of immunological tests designed to assess both humoral and cell-mediated immunity, as well as the innate immune response, will be conducted at 1, 3, 6, and 12 months. This four-year study has the following milestones.

Year 1

- implant 24 month animals
- implant 18 month animals
- implant 3 month animals
- assess immune system function of 3 month animals
- implant 6 month animals

Year 2

- compile immunological data on 3 month animals
- necropsy, histopathology, mutagenicity, cytogenicity, and immune system function assessment of 6 month animals
- implant 12 month animals
- necropsy, histopathology, mutagenicity, cytogenicity, and immune system function assessment of 18 month animals
- compile experimental data on 6 month animals

Year 3

- compile experimental data on 18 month animals
- necropsy, histopathology, mutagenicity, cytogenicity, and immune system function assessment of 24 month animals
- necropsy, histopathology, mutagenicity, cytogenicity, and immune system function assessment of 12 month animals
- implant 1 month animals
- start compilation of experimental data on 24 month animals

Year 4

- finish compilation of experimental data on 24 month animals
- compile experimental data on 12 month animals

- assess immune system function of 1 month animals
- compile immunological data on 1 month animals
- analyze all data
- provide final report

Progress to Date

This report summarizes accomplishments for the first year of this four-year study. The project was delayed from starting for 2-3 months as a result of two procurement problems: one with tungsten alloy pellets and the other with the NTP2000 diet required for our studies. The tungsten pellet procurement problem arose because of our decision to choose a different vendor than originally planned. The change, however, allowed us to obtain superior pellets at less cost, but it also delayed our receiving them. Additional time was lost because of arranging the contract required to obtain the NTP-2000 rat chow, a custom-order commodity.

The delays mean that we are just now undertaking the 3-month implantation surgeries, and the 3-month immune assessments, both of which are first year milestones. However, because we are adjusting future schedules to make up the lost time, we expect to meet or exceed all of our current second year and later milestones. We therefore are not requesting a change in our future milestones.

Accounting for the initial delays, the project is otherwise proceeding as planned. During this year we successfully completed a number of important steps required for the project to proceed. Our first step was to design a detailed calendar of events to guide us for the entire project. This day-by-day four-year schedule includes dates for all routine animal monitoring procedures, pellet implantation surgeries, animal euthanasia, assays of recovered tissues, and histological examinations. The first year schedule is attached as Appendix 1. We also designed and established a new animal surgery facility specifically for this project. We tested the facility by performing a series of sham pellet implantation surgeries on rats. The surgeries allowed us to standardize a new rat anesthesia system, improved surgical closure techniques, and new approaches for post-operative pain alleviation and prevention of infection. We tested various animal husbandry requirements recently introduced into our institute. We also tested a variety of novel systems to identify the individual rats involved in the study, deciding ultimately on traditional ear tagging.

The first delivery of rats for the studies was received in late February 2002, and we began pellet implantation surgeries in March 2002. With periodic rat deliveries since then, we had by the first anniversary of the project (mid September 2002), received approximately 300 rats into the study (of the 675 that will ultimately be required). Most of the rats that we have received have undergone pellet implantation surgery, with others serving as sham-surgical controls, non-surgical controls, and test and back-up animals. The pellet-implanted rats received various numbers and combinations of metal pellets as dictated by our protocols and timelines. For the DU and HMTA carcinogenicity part of the project, we implanted the 6-, 12-, and 24-month tantalum control groups (36 rats total), the 6-, 12-, and 24-month low DU groups (36 rats total), the 6-, 12-, and 24-month high DU groups (36 rats total), the 6-, 12-, and 24-month low tungsten alloy groups (36 rats total), the 6-, 12-, and 24-month high tungsten alloy groups (36 rats total), and the 6-, 12-, and 24-month nickel pellet groups (36 rats total). For the DU and HMTA immunotoxicity part of the project, we completed the 6- and 12-month tantalum control group (10 rats), the 12-month low DU group (10 rats), and the 12-month high DU group (10 rats).

All rats have been closely monitored from the time they arrived at the Institute. Monitoring includes weekly body weight measurements, routine handling of the animals to reduce stress during manipulations, and basic assessments of health. We have experienced no losses of animals because of surgery or post-surgical complications.

In parallel with the animal surgeries, we have initiated testing and standardization of our inductively coupled plasma mass spectrometer (ICPMS) instrument for the various metal measurements required for this study. Metals to be measured are uranium (including constituent uranium isotopes), tantalum, tungsten, nickel, and cobalt. We have prior, extensive experience with uranium measurements. Sensitive measurement of metal distributions to tissues is an integral part of validating any abnormalities that we might see in the pellet-implanted rats.

To summarize, even though the planned initiation of our experiments was delayed by several months, the project is proceeding as planned. We expect that the lost months will be made up by the end of year two. Experimental methods to be used have been tested and standardized. We have encountered no experimental problems to date that require modification of our original plans and goals.

KEY RESEARCH ACCOMPLISHMENTS

Our accomplishment for the first year is initiating the project. The study will not begin to produce any reportable experimental results until the second and third year of the project.

REPORTABLE OUTCOMES

None to date

CONCLUSIONS

None to date. This report summarizes the first year of the project. During this period, we have been involved primarily in starting experiments that will begin generating results beginning the second year of the project.

REFERENCES

None

APPENDICES

Appendix 1: Detailed Project Schedule for Year One (Attached)

FEBRUARY 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
					1 Order Harlan Fischer 344s for NS, TC, & DL groups	2
3	4 Test anesthesia machine with 2 rats: #1T and #2T	5 See Betty Lou about DU Rad Refresher for VSD & marking VSD animal room 2513	6 Get Buprenex and Isoflurane from USUHS pharmacy	7 Implant #3T and #4T	8	9
10	11	12 Implant #5T, 6T, & 7T	13	14 Remind Mike Morris about NTP-2000 rat chow	15	16
17	18 HOLIDAY	19	20 Implant 5 training rats: #8T, 9T, 10T, 1T, & 2T	21	22 Order Harlan Fischer 344s for DH & WL groups	23
24	25 Euthanize Training Rats #3T, 4T, 5T, & 6T 16 F344s arrive for NS Group	26 Euthanize Training Rats #1T, 2T, 7T, & 8T	27	28 Euthanize Training Rats #9T & 10T		

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MARCH 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
					1	2
3	4 **14 for TC group**	5	6	7 **Determine weekly food scoop size per rat/cage** (1 6 oz/150 g scoop per rat)	8	9
10	11 **Ear Tag #001-016 NS Group** [24M-01-NS to 24M-16-NS] **16 for TC/DL group** Check animals	12 Check animals	13 **Order Harlan Fischer 344s for WH & NH groups** **Prep packs for TC group** Check animals	14 **Weekly Body Weights (16)** Clean all ear tags **Mike Morris - NTP-2000** Check animals	15 **Prep forms for TC group** Check animals	16
17	18 **▶Implant 5 TCs #017-021** [24M-01-TC to 24M-05-TC] Check animals	19 **▶Implant 5 TCs #022-026** [24M-06-TC to 24M-10-TC] **18 for DL/DH group** **Prep packs for TC group** Check animals	20 **▶Implant 4 TCs #027-030** [24M-11-TC to 24M-14-TC] **Prep packs for TC/DL group** Check animals	21 **Weekly Body Weights (30)** Clean all ear tags Check animals	22 **Prep forms for DL group** Check animals	23
24/31	25 **▶Implant 2 TCs #031-032** [24M-15-TC & 24M-16-TC] **▶Implant 3 DLs #033-035** [24M-01-DL to 24M-03-DL] Check animals	26 **▶Implant 6 DLs #036-041** [24M-04-DL to 24M-09-DL] **16 for WL group** **Prep packs for DL group** Check animals	27 **▶Implant 5 DLs #042-046** [24M-10-DL to 24M-14-DL] **Prep packs for DL/DH group** Check animals	28 **Weekly Body Weights (46)** Clean all ear tags Check animals	29 **Prep forms for DH group** Check animals	30

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APRIL 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
	1 ▶**Implant 2 DLs #047-048** [24M-15-DL & 24M-16-DL] ▶**Implant 4 DHs #049-052** [24M-01-DH to 24M-04-DH] **16 for WH group** Pair 017/018 & 019/020	2 ▶**Implant 6 DHs #053-058** [24M-05-DH to 24M-10-DH] Pair 021/022, 023/024, & 0250/26	3 ▶**Implant 6 DHs #059-064** [24M-11-DH to 24M-16-DH] **Prep packs for WL group** Pair 027/028 & 029/030	4 **Weekly Body Weights (64)** Clean all ear tags Cage cards for WL group Check animals	5 **Prep forms for WL group** **Count HMTA & Ta pellets** Update subject info sheets Check animals	6
7	8 ▶**Implant 5 WLs #065-069** [24M-01-WL to 24M-05-WL] **16 for NH group** Pair 031/032 & 033/034	9 ▶**Implant 6 WLs #070-075** [24M-06-WL to 24M-11-WL] Pair 035/036, 037/038, & 039/040	10 ▶**Implant 5 WLs #076-080** [24M-12-WL to 24M-16-WL] **Prep packs for WH group** Pair 041/042, 043/044, & 045/046	11 **Weekly Body Weights (80)** Clean all ear tags Cage cards for WH group Check animals	12 **Order 70 F344s for 12M Group** **Prep forms for WH group** **Count HMTA & Ta pellets** Update subject info sheets Check animals	13
14	15 ▶**Implant 5 WHs #081-085** [24M-01-WH to 24M-05-WH] Pair 047/048, 049/050, & 051/052	16 ▶**Implant 6 WHs #086-091** [24M-06-WH to 24M-11-WH] Pair 053/054, 055/056, & 057/058	17 ▶**Implant 5 WHs #092-096** [24M-12-WH to 24M-16-WH] **Prep packs for NH group** Pair 059/060, 061/062, & 063/064	18 **Weekly Body Weights (96)** Clean all ear tags Cage cards for NH group Check animals	19 **Prep forms for NH group** **Count Nickel pellets** Update subject info sheets Check animals	20
21	22 ▶**Implant 5 NHs #097-101** [24M-01-NH to 24M-05-NH] Pair 065/066 & 067/068	23 ▶**Implant 6 NHs #102-107** [24M-06-NH to 24M-11-NH] Pair 069/070, 071/072, & 073/074	24 ▶**Implant 5 NHs #108-112** [24M-12-NH to 24M-16-NH] Pair 075/076, 077/078, & 079/080	25 **Weekly Body Weights (112)** Clean all ear tags Check animals	26 Update subject info sheets Check animals	27
28	29 Pair 081/082 & 083/084	30 Pair 085/086, 087/088, & 089/090				

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MAY 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
			1 Pair 91/92, 93/94, & 95/96	2 **Weekly Body Weights (112)** Clean all ear tags Check animals	3 Check animals	4
5	6 Pair 97/98 & 99/100	7 Pair 101/102, 103/104 & 105/106	8 Pair 107/108, 109/110 & 111/112	9 **Weekly Body Weights (112)** Clean all ear tags Check animals	10 Check animals	11
12	13 **10 in for 12M/M NS group** Check animals	14 Check animals	15 **Weekly Body Weights (112)** Clean all ear tags Check animals	16 Check animals	17 Check animals	18
19	20 **15 in for 12M/M TC/DL group** Check animals	21 Check animals	22 **Mike Morris - NTP-2000** Check animals	23 **Weekly Body Weights (112)** Clean all ear tags Check animals	24 **Prep forms for NS group** **Count Ta pellets** Prep subject info sheets Check animals	25
26	27 HOLIDAY	28 **Ear Tag #113-122 12M/M NS** [12M-01-NS to 12M-10-NS] **15 in for 12M/M DL/DH group** Check animals	29 Check animals	30 **Weekly Body Weights (122)** Clean all ear tags **Prep packs for TC/DL group** Check animals	31 **Prep forms for TC/DL groups** **Count Ta & DU pellets** Update subject info sheets Check animals	

JUNE 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
						1
2	3 ▶Implant 5 TCs #123-127 [12M-01-TC to 12M-05-TC] 15 in for 12M/M WL/WH group Check animals	4 ▶Implant 5 TCs #128-132 [12M-06-TC to 12M-10-TC] Check animals	5 ▶Implant 5 DLs #133-137 [12M-01-DL to 12M-05-DL] Check animals	6 Weekly Body Weights (137) Clean all ear tags Prep packs for DL/DH group Check animals	7 Prep forms for DL/DH groups Count Ta & DU pellets Update subject info sheets Check animals	8
9	10 ▶Implant 5 DLs #138-142 [12M-06-DL to 12M-10-DL] 15 in for 12M/M WH/NH group Check animals	11 ▶Implant 5 DHs #143-147 [12M-01-DH to 12M-05-DH] Check animals	12 ▶Implant 5 DHs #148-152 [12M-06-DH to 12M-10-DH] Check animals	13 Weekly Body Weights (152) Clean all ear tags Prep packs for WL/WH group Check animals	14 Prep forms for WL/WH groups Count Ta & HMTA pellets Update subject info sheets Check animals	15
16	17 ▶Implant 5 WLs #153-157 [12M-01-WL to 12M-05-WL] Pair 123/124 & 125/126	18 ▶Implant 5 WLs #158-162 [12M-06-WL to 12M-10-WL] Pair 127/128, 129/130 & 131/132	19 ▶Implant 5 WHs #163-167 [12M-01-WH to 12M-05-WH] Pair 133/134 & 135/136	20 Weekly Body Weights (167) Clean all ear tags Mike Morris - NTP-2000 Prep packs for WH/NH group Check animals	21 Prep forms for WH/NH groups Count Ta & DU pellets Update subject info sheets Check animals	22
23/30	24 ▶Implant 5 WHs #168-172 [12M-06-WH to 12M-10-WH] Pair 137/138, 139/140 & 141/142	25 ▶Implant 5 NHs #173-177 [12M-01-NH to 12M-05-NH] Pair 143/144 & 145/146	26 ▶Implant 5 NHs #178-182 [12M-06-NH to 12M-10-NH] Pair 147/148, 149/150 & 151/152	27 Weekly Body Weights (182) Clean all ear tags Check animals	28 Form 38s for 70 F344s needed for 6M/M group in August Update subject info sheets Check animals	29

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JULY 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
	1 Pair 153/154 & 155/156	2 **Order 85 F344s for 6M/M & 12M/K Groups** Pair 157/158, 159/160 & 161/162	3 **Weekly Body Weights (182)** Clean all ear tags Pair 163/164 & 165/166	4 HOLIDAY	5 Check animals	6
7	8 Pair 167/168, 169/170 & 171/172	9 Pair 173/174 & 175/176	10 Pair 177/178, 179/180 & 181/182	11 **Weekly Body Weights (182)** Clean all ear tags Check animals	12 Check animals	13
14	15 Check animals	16 Check animals	17 **Mike Morris - NTP-2000** Check animals	18 **Weekly Body Weights (182)** Clean all ear tags Check animals	19 Check animals	20
21	22 Check animals	23 Check animals	24 Check animals	25 **Weekly Body Weights (182)** Clean all ear tags Check animals	26 Check animals	27
28	29 Check animals	30 Check animals	31 Check animals			

AUGUST 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
				1 **Weekly Body Weights (182)** Clean all ear tags Check animals	2 Check animals	3
4	5 **10 in for 6M/M NS group** Check animals	6 Check animals	7 Check animals	8 **Weekly Body Weights (182)** Clean all ear tags Check animals	9 Check animals	10
11	12 **Order 85 F344s for 12M/K & 6M/K Groups** **15 in for 6M/M TC/DL group** Check animals	13 Check animals	14 **Mike Morris - NTP-2000** Check animals	15 **Weekly Body Weights (182)** Clean all ear tags Check animals	16 Check animals	17
18	19 **10 in for 6M/M DL/DH group** Check animals	20 **Ear Tag #183-192 6M/M NS** [6M-01-NS to 6M-10-NS] Check animals	21 Check animals	22 **Weekly Body Weights (192)** Clean all ear tags Check animals	23 **Prep forms for TC/DL groups** **Count Ta & DU pellets** Update subject info sheets Check animals	24
25	26 **▶Implant 5 TCs #193-197** [6M-01-TC to 6M-05-TC] **15 in for 6M/M DH/WL group** Check animals	27 **▶Implant 5 TCs #198-202** [6M-06-TC to 6M-10-TC] Check animals	28 **▶Implant 5 DLs #203-207** [6M-01-DL to 6M-05-DL] Check animals	29 **Weekly Body Weights (207)** Clean all ear tags Check animals	30 **Prep forms for DL/DH groups** **Count Ta & DU pellets** Update subject info sheets **⇉#088 Euthanized** Check animals	31

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SEPTEMBER 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
1	2 HOLIDAY	3 ▶Implant 5 DLs #208-212 [6M-06-DL to 6M-10-DL] 10 in for 6M/M WH group 10 in for 12M/K NS group	4 ▶Implant 5 DHs #213-217 [6M-01-DH to 6M-05-DH] Order 60 F344s for 18M Group Check animals	5 Weekly Body Weights (217) Clean all ear tags ⇉# 082, 089 & 096 Euthanized Check animals	6 Prep forms for DH/WL groups Count Ta, DU & HMTA pellets Update subject info sheets Check animals	7
8	9 ▶Implant 5 DHs #218-222 [6M-06-DH to 6M-10-DH] 10 in for 6M/M NH group 5 in for 12M/K TC group Pair 193/194 & 195/196	10 ▶Implant 5 WLs #223-227 [6M-01-WL to 6M-05-WL] Pair 197/198, 199/200 & 201/202	11 ▶Implant 5 WLs #228-232 [6M-06-WL to 6M-10-WL] Pair 203/204 & 205/206	12 Weekly Body Weights (232) Clean all ear tags ⇉# 076, 083 & 085 Euthanized Check animals	13 Prep forms for WH/NS groups Count HMTA pellets Update subject info sheets Check animals	14
15	16 ▶Implant 5 WHs #233-237 [6M-01-WH to 6M-05-WH] 10 in for 12M/K TC/DL group 10 in for 6M/K NS group Pair 207/208	17 ▶Implant 5 WHs #238-242 [6M-06-WH to 6M-10-WH] Pair 209/210 & 211/212	18 Ear Tag #253-262 NS Group [12M-11-NS to 12M-20-NS] ⇉# 084 & 093 Euthanized Pair 213/214 & 215/216	19 Weekly Body Weights (252) Clean all ear tags Mike Morris - NTP-2000 ⇉# 067, 069 & 071 Euthanized Check animals	20 Prep forms for NH/TC groups Count Ta & Ni pellets Update subject info sheets ⇉# 086, 090 & 092 Euthanized Check animals	21
22	23 ▶Implant 5 NHs #243-247 [6M-01-NH to 6M-05-NH] 10 in for 12M/K DL/DH group 5 in for 6M/K TC group ⇉# 070 Euthanized Pair 217/218, 219/220 & 221/222	24 ▶Implant 5 NHs #248-252 [6M-06-NH to 6M-10-NH] ⇉# 065 & 091 Euthanized Pair 223/224 & 225/226	25 ▶Implant 5 TCs #263-267 [12M-11-TC to 12M-15-TC] ⇉# 094 & 095 Euthanized Pair 227/228, 229/230 & 231/232	26 Weekly Body Weights (267) Clean all ear tags Check animals	27 Prep forms for TC/DL/NS groups Count Ta & DU pellets Update subject info sheets Check animals	28
29	30 ▶Implant 5 TCs #268-272 [12M-16-TC to 12M-20-TC] 5 in for 12M/K DH group 5 in for 6M/K TC group ⇉# 072 Euthanized Pair 233/234 & 235/236					

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OCTOBER 2002

Sunday	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	Saturday
		1 ▶Implant 5 DLs #273-277 [12M-11-DL to 12M-15-DL] Pair 237/238, 239/240 & 241/242	2 Ear Tag #383-392 6M/K NS [6M-11-NS to 6M-20-NS] ⇉#108 Euthanized Check animals	3 Weekly Body Weights (287) Clean all ear tags ⇉# 081 & 087 Euthanized Check animals	4 Prep forms for TC/DL/DH groups Count Ta & DU pellets Update subject info sheets Check animals	5
6	7 ▶Implant 5 DLs #278-282 [12M-16-DL to 12M-20-DL] 10 in for 12M/K WL group 5 in for 6M/K DL group Pair 243/244 & 245/246	8 ▶Implant 5 DHs #283-287 [12M-11-DH to 12M-15-DH] Pair 247/248, 249/250 & 251/252	9 ▶Implant 5 TCs #393-397 [6M-11-TC to 6M-15-TC] Pair 263/264 & 265/266	10 Weekly Body Weights (302) Clean all ear tags ⇉#098 & 103 Euthanized Check animals	11 Prep forms for TC/DH groups Count Ta & DU pellets Update subject info sheets ⇉#075 & 080 Euthanized Check animals	12
13	14 HOLIDAY	15 ▶Implant 5 DHs #288-292 [12M-16-DH to 12M-20-DH] 10 in for 12M/K WH group 10 in for 18M NS group 5 in for 6M/K DL group Pair 267/268, 269/270 & 271/272	16 ▶Implant 5 TCs #398-402 [6M-16-TC to 6M-20-TC] Pair 273/274 & 275/276	17 Weekly Body Weights (312) Clean all ear tags Mike Morris - NTP-2000 Check animals	18 Prep forms for WL/DL groups Count Ta, DU & HMTA pellets Update subject info sheets Check animals	19
20	21 ▶Implant 5 WLs #293-297 [12M-11-WL to 12M-15-WL] 15 in for 18M TC/DL group Pair 277/278, 279/280 & 281/282	22 ▶Implant 5 WLs #298-302 [12M-16-WL to 12M-20-WL] Pair 283/284 & 285/286	23 ▶Implant 5 DLs #403-407 [6M-11-DL to 6M-15-DL] Pair 393/394 & 395/396	24 Weekly Body Weights (327) Clean all ear tags Check animals	25 Prep forms for WH/DL/NS groups Count Ta, DU & HMTA pellets Update subject info sheets Check animals	26
27	28 ▶Implant 5 WHs #303-307 [12M-11-WH to 12M-15-WH] 10 in for 18M DL/DH group	29 ▶Implant 5 WHs #308-31 [12M-16-WH to 12M-20-WH] Pair 287/288, 289/290 & 291/292	30 ▶Implant 5 DLs #408-412 [6M-16-DL to 6M-20-DL] Ear Tag #313-322 18M NS [18M-01-NS to 18M-10-NS] Pair 397/398, 399/400 & 401/402	31 Weekly Body Weights (352) Clean all ear tags Check animals		